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GEOPHYSICS.—*The variation of latitude and the fluctuations in the motion of the moon.*[1] WALTER D. LAMBERT, U. S. Coast and Geodetic Survey.

E. W. Brown's[2] explanation of the apparently irregular fluctuations in the motion of the moon involves an expansion or contraction of the earth over irregular periods of years, decades or perhaps even centuries so as to change its principal moment of inertia with respect to the axis of rotation, the moment of angular momentum remaining constant. This involves a change in the going of our time-keeper, the earth, and hence a seeming change in the moon's place at any given time as shown by our clocks, not a real change in the motion of the moon itself. Brown's explanation does not require an expansion or contraction uniform along all radii but merely a contraction or expansion having an adequate *average* value. The surface of the earth is so diversified that it seems natural to assume an expansion different along different radii, at least in the outer portions. The principal axis would then shift its position, that is, products of inertia different from zero would be introduced.

Such a non-uniform expansion and contraction of the earth would be very convenient for explaining irregularities in the variation of latitude. I am considering variation of latitude only so far as it concerns shifting of the earth's axis of rotation, and shall treat *variation* of *latitude* and *motion of the pole* as practically synonymous. The

[1] Presented at a meeting of the American Astronomical Society, Philadelphia, December 29, 1926. Received February 2, 1927.

[2] *The Evidence for Changes in the Rate of Rotation of the Earth and their Geophysical Consequences, with a Summary and Discussion of the Deviations of the Moon and Sun from their Gravitational Orbits.* Transactions of the Astronomical Observatory of Yale University, **3**: part 6.

annual portion of the polar motion has seemed to vary about as regularly as one might be led to expect from the variations in the annual phenomena—meteorological phenomena in the broad sense of the term—to which the annual part of the variation is commonly and convincingly attributed. But the variations in the "free" period of 14 months are much more puzzling. Friction would inevitably damp out the free motion unless there were something to sustain or regenerate it. Although there is reason, to believe that the internal friction is small,[3] we can hardly suppose that the present free motion is the still undestroyed part of a motion that has gone on with decreasing amplitude since some early geologic era. Moreover, there have been frequent and puzzling changes in the amplitude and phase of the free motion.

Earthquakes have been correlated with the variation of latitude, but the masses moved in known earthquakes appear on calculation to be inadequate to account for the observed peculiarities in the variation of latitude. On the other hand, the stresses due to the variation of latitude, assumed to exist, are very small, even when considered as mere "trigger" phenomena, that is, as stresses that do not of themselves cause earthquakes, but are merely the final increment of stress that pushes the accumulated and pre-existing stresses beyond the limits of crustal strength and so releases at some particular time an earthquake that would have occurred about that time anyway. Considered as a trigger phenomenon the variation of latitude gives stresses of precisely the same character as those due to the diurnal earth tides, but the stresses due to the average maximum diurnal earth tide, which occurs about once a fortnight, are about twelve times as large as those due to the largest usual maximum displacement of the pole. The trigger effect of the variation of latitude may therefore be disregarded. If, however, earthquakes and the irregularities in variation of latitude are both due to one common cause, the shrinking and swelling of the earth, the suspected correlation is easier to explain.

What seems to be needed is some deformation of the earth containing a spherical harmonic component of the second degree and first order, that is, a change in the products of inertia xz and yz, where the z-axis is the axis of rotation, a deformation by no means large, but from its very definition widely distributed.

[3] See HAROLD JEFFREYS: *The Earth, Its Origin, History and Physical Constitution*, Chapter XIV. This contains a convenient summary of recent work, much of it done by Jeffreys himself.

What has been said with regard to the "free" motion applies also to the irregular motion, which seems to defy all analysis into periods, or at any rate a rational explanation of those periods into which the motion may have been forced by some Procrustean mathematical process. For instance, for some years prior to 1918, the mean north pole appears to have moved progressively towards North America, and then to have turned aside without apparent reason and moved in the general direction of Europe.[4]

All these phenomena find a natural explanation if only we can assume that the expansions and contractions of the earth suggested by Brown take place, but not with absolute uniformity in all parts of the earth. Indeed the diversity of the surface suggests diversity of behavior, especially as the expansions and contractions, in both Brown's opinion and mine, are probably confined to the outer portions of the earth. A departure from uniformity amounting to only a fraction of the average expansion or contraction necessary to explain the anomalies of the moon's motion would be of the right order of magnitude to explain the irregularities in the variation of latitude.[5]

Of course this expansion and contraction, uniform or otherwise, is for the present a *deus ex machina*, a makeshift hypothesis, the geophysical implications of which we cannot well consider in detail just now.

The interesting thing is of course to see whether the irregularities in the variation of latitude do in fact correspond to fluctuations in the lunar motions. The investigation is not easy, for trustworthy observations of the variation of latitude do not extend nearly so far back as do reliable observations of the moon. In both cases we are dealing with quantities small and none too well determined. Hence one is peculiarly liable to be led astray by a seductive theory and to attribute a deep significance to mere chance coincidences.

[4] LAMBERT: *An Investigation of the Latitude of Ukiah, Calif., and of the Motion of the Pole*. U. S. Coast and Geodetic Survey Special Publication No. 80 p. 42 and 108.

KIMURA: *Provisional Results of the Work of the International Latitude Service*—September 6, 1922, March 6, 1924. Japanese Journal of Astronomy and Geophysics, **2**: No. 3. 1924.

[5] For effects of shifts of matter in displacing the pole see LARMOR and HILLS: *The Irregular Movement of the Earth's Axis of Rotation*, etc. Monthly Notices Royal Astronomical Society, **67**: 22. 1906.

LARMOR: *On irregularities in the Earth's Rotation*, etc. Monthly Notices Royal Astronomical Society, **75**: 211. 1915.

LAMBERT: Op. cit., pp. 37–42.

See also addendum to this paper.

I profess no real familiarity with the difficult technical questions involved in a study of the lunar motions. Nevertheless, I have come to suspect, as a result of examining the records, that there may be a close connection between irregularities in the motion of the moon and irregularities in the variation of latitude. The corrections to the moon's tabular place, as determined by observation, seem to vary most rapidly, at just about those times when there is a sudden change in amplitude or phase of the free motion of the pole, or a marked progressive shifting of the mean pole.

In Brown's Fig. 1 (op. cit.) there is a sudden upturn about 1918 of the curve showing the correction to the moon's longitude, just about the time when the mean pole suddenly changed its direction of motion, as previously noted. There is a smaller irregularity in correction to the moon's longitude about 1907, about the time of a considerable increase in amplitude of the free motion of the pole, and about the time when the progressive displacement of the pole appears to have slowed down for a time.[6] Changes *per saltum* in the earth's moment of inertia would tend to give the curve of corrections to the moon's longitude sudden changes from one uniform slope to another slope likewise uniform and if accompanied by a change *per saltum* in the product of inertia would in general change the amplitude and phase of the free motion, and also the position of the mean pole but would not impart to it a progressive displacement.

This study has been more than a mere casual inspection but should not be dignified with the name of an exhaustive investigation. My chief purpose in putting the matter before you is to ask advice and suggestions from those who are familiar with either latitude problems or with lunar problems, or with both, so that it may be easier to detect real connections, if such exist, and to rule out apparent coincidences due to change and to prepossession in favor of a preconceived theory.[7]

[6] LAMBERT: (Op. cit.) p. 60 and figures 4a to 9b, pp. 21–28. This change is so small both for the moon and the pole that its reality is not beyond doubt.

[7] Since the above paper was presented discussion of the uniformity of the earth's rate of rotation at the meeting of the Royal Astronomical Society on November 12, 1926, as reported in *The Observatory* for December, 1926, has come to my attention. The participants in the discussion agreed that the evidence for irregularity of rotation is strong, but some attributed the changes to changes in the earth's angular velocity alone with the moment of inertia left unchanged. For the mathematical theory of this assumption see addendum to Larmor's article previously cited, Monthly Notices Royal Astronomical Society, **75**: 218. 1915, and Glauert's article in same volume p. 492. The paper by H. S. JONES, which was read at this meeting, appears in the Monthly Notices, **87**: 4. November, 1926.

ADDENDUM TO THE PRECEDING PAPER

(Jan. 28, 1927)

Suppose the surface of the earth to rise in some places and to sink in others. This change in the radius may be expressed by a series of spherical harmonic terms. It can readily be shown that most of the harmonic terms give zero effects in displacing the polar axis of figure. The only exceptions are the harmonic terms of degree two and order one; these may be represented by $h_1 \sin 2\phi \cos \lambda$ and $h_2 \sin 2\phi \sin \lambda$. ($\phi$ = latitude, λ = longitude). By a proper choice of the initial meridian these two terms may be reduced to one, $h \sin 2\phi \cos \lambda$. This is the only term in the expression for change of radius that needs to be considered in treating the displacement of the axis of figure. For slow displacements the pole of rotation tends to follow the axis of figure, and in this note no distinction is made between the two.

If this term represents a layer of matter of density σ added or removed up to a maximum height or depth of h, the corresponding displacement of the pole expressed in radians is

$$\Delta\phi = \frac{8\pi\sigma\, h\, a^4}{15\,(C-A)},$$

where a = radius of earth, and C and A are its principal moments of inertia about the polar axis and about an equatorial axis respectively. By introducing the values of C and A in terms of the earth's dimensions and density and of a we get for $\Delta\phi$ in seconds of arc

$$\Delta\phi = 7''.54 \times 10^7 \times \frac{\sigma}{\rho} \times \frac{h}{a},$$

where ρ is the mean density of the earth. Suppose now that change in radius is due not to addition and removal of a layer of matter, but by the swelling and shrinking up of matter down to a depth d below the surface. The change in elevation is thus compensated isostatically in the Pratt manner down to depth d. The corresponding displacement of the pole is much smaller, being in fact the expression above multiplied by $\frac{d}{a}$, that is

$$\Delta\phi = 7''\,54 \times 10^7 \times \frac{\sigma}{\rho} \times \frac{h}{a} \times \frac{d}{a}$$

As a numerical example take:

$\frac{\sigma}{\rho} = 0.6, h = 1$ meter and $\frac{d}{a} = \frac{1}{60}$, or $d = 106$ kilometers approximately;

we get

$$\Delta\phi = 0''.12.$$

This displacement is of the right order of magnitude to explain the irregularities in the variation of latitude, though in most cases several times larger than would be needed.

The average shrinking or swelling postulated by Brown to explain the motion of the moon varies from a few inches, when the expansion and contraction extends to the center of the earth, up to 12 feet when it goes down only to the depth of isostatic compensation, as in the example above.[8] In view of the diversity of the earth's surface there is no difficulty in imagining an irregularity of less than a meter in an average shrinking or swelling of twelve feet.

The difficulty with the hypothesis—other than the primal one of finding a cause for the shrinking and swelling—lies in the matter of sea level.[9] A uniform expansion or contraction would cause merely a very slight lowering or raising of sea level due to the increased or decreased area of the ocean basins, but an irregular expansion or contraction of an amount necessary to account for irregularities in the variation of latitude would cause oscillations of sea level that would be well within the limits of observation, that would in fact almost force themselves on one's attention.

A change in level due to the addition or removal of a layer of matter would be largely masked by the rise or fall in sea level due to the attraction of the layer and the change in level produced by the displacement of the pole, but this is not true of the change in radius produced by mere shrinking and swelling down to a moderate depth. Such changes in radius may be considered as isostatically compensated and as having therefore very little effect on sea level.

The suggestion[10] has been made that a not unreasonable change in the volume of the circumpolar ice sheets[11] might effect a change in

[8] Correspondence with Prof. Brown develops the fact that he had in mind a different mode of expansion, namely, expansion in a thin layer just below the outer crust so as to push up the latter without altering its density. For a given elevation or depression of the surface an expansion of the type intended by Brown would be twice as effective in altering the moments and products of inertia as the type here treated.

[9] Dr. William Bowie called my attention to this.

[10] This suggestion was communicated in a personal letter from Dr. Harold Jeffreys of St. John's College, Cambridge, who attributes it to Prof. J. W. Evans. Jeffreys is to discuss it briefly in an early issue of The Observatory.

[11] There are known to be gradual increases and decreases in these due to slight climatic fluctuations of obscure origin. It would be very interesting to make a quantitative study if all the material were available.

the moment of inertia of the earth sufficient to cause the irregularities in its rotation that are reflected in the apparent errors in the lunar tables. The effect of an increase in the ice sheets would probably be to *decrease* the moment of inertia by lowering the level all over the ocean surface, which lies mostly in latitudes where the lowering would affect the moment of inertia more than in the high latitudes of the ice sheets.

On account of the lack of symmetry of the configuration of the continents and oceans a withdrawal of water from the ocean or an addition of water to it would produce an effect on the position of the earth's axis of figure. The quadratures made by Darwin and Turner[12] for a different purpose may be used for evaluating the effect. If enough circumpolar ice were melted to raise the ocean level one meter, the pole would be shifted by 0″. 22, which is several times as much as is needed to explain most of the irregular variation of latitude. The direction of displacement is such that the north pole would move southward along the meridian of 59° East of Greenwich. The moment of inertia with regard to the axis of rotation would be increased by about one part in ten million. This again is a quantity several times as large as the largest change needed by Brown to explain the irregularities of the moon. These figures are on the supposition that there is no yielding of the solid portion of the earth under the load of water. On account of elastic yielding they are subject to a slight diminution, especially those for the variation of latitude, which would be reduced to perhaps four-fifths of the amount given, the direction of the polar displacement being unchanged.

Prof. Evans' explanation of the lunar puzzle thus fits the latitude puzzle also in regard to the order of magnitude of the quantities involved. The amount of water required to be added or withdrawn, that is, say 10 to 30 centimeters, does not seem wildly unreasonable, though larger than can be readily granted. The explanation is probably therefore only a partial one.

The apparent tendency, previously noted for the irregularities in the motion of the moon and in the displacement of the pole to occur simultaneously is an indication at least that the phenomena are related and that the cause of the lunar irregularities is chiefly terrestrial. The alternate release and storage of water in the polar ice caps occurring in the slow oscillations of irregular climatic cycles may be an important element of both phenomena.

[12] On the *Correction to the Equilibrium Theory of Tides for the Continents*. Proceedings Royal Society of London, **40**: 303. 1886, or Darwin's Scientific Papers, **1**: 328.

BOTANY.—*Two new grasses,* Psammochloa mongolica *from Mongolia and* Orthachne breviseta *from Chile.*[1] A. S. HITCHCOCK, Bureau of Plant Industry.

Recently a package of grasses was received from Dr. E. D. Merrill, comprising the grass part of the collections of Mr. R. W. Chaney on the Third Asiatic Expedition of the American Museum of Natural History. Several interesting species were found, one of which appears to be new and to constitute a new genus.

Psammochloa Hitchc., gen. nov.

Spikelets 1-flowered, the rachilla articulating above the glumes, not prolonged behind the palea; glumes about equal; lemma narrow, about as long as the glumes, membranaceous, villous, awned from between 2 minute blunt lobes, the awn deciduous; palea narrow, villous, as long as the lemma and not inclosed in it; anthers large, minutely pointed, bearing a few short stiff hairs.—A stout perennial rhizomatous grass with long narrow compound panicles. The genus differs from *Stipa* in the membranaceous lemma without a strong callus, in the weak deciduous awn and in the equal palea not inclosed. The pilose-tipped anthers show a relationship to *Stipa* through the section *Lasiagrostis.* In aspect it resembles *Calamovilfa* but the callus is not bearded.

Fig. 1.—Spikelet and floret of *Psammochloa mongolica,* × 5 dia.; anther tip × 10 dia.

Psammochloa mongolica Hitchc., sp. nov.

Culms 1 to 1.5 meters tall, erect, glabrous, from strong rhizomes; sheaths glabrous; ligule thin, about 1 cm. long; blades firm, glabrous, flat or soon involute, elongate, strongly nerved on the upper surface, 5 to 10 mm. wide, extending into a long fine involute point; panicle one-third to half the height of the plant, narrow, erect, pale and shining, the branches ascending or appressed, only slightly scabrous; spikelets about 1 cm. long, longer than the scaberulous pedicels; glumes equal, narrow, acute, weakly nerved, puberulent; lemma about as long as the glumes, narrow, villous, the awn weak, straight or somewhat flexuous, 8 to 10 mm. long, early deciduous; palea narrow, as long as the lemma, villous, not inclosed at maturity.

Type in the U. S. National Herbarium, no. 1,296,544, collected at Tsagan Nor, Outer Mongolia, on dunes at 1000 meters altitude, in 1925, by R. W. Chaney (no. 502) on the Third Asiatic Expedition of the American Museum of Natural History. A second specimen was collected at Gatun Bologai, on dunes, *Chaney* 443.

[1] Received January 18, 1927.

In 1847 Hooker published a new species of *Muhlenbergia* (*M. rariflora* Hook. f.[2] from Cape Tres Montes, southern Chile, where it was collected by Darwin. Later this species was independently described by Steudel under a new genus, *Orthachne* (*O. retorta* Nees in Steud.)[3] and based on the same collection cited above. Miss D. K. Hughes (now Mrs. Wilson Popenoe) established the identity of the two species and took up the earlier specific name as *Orthachne rariflora* (Hook f.) Hughes.[4]

In a recent collection of Chile plants made by Dr. E. Werdermann, received from the Gray Herbarium of Harvard University, there was a new species which appears to be congeneric with the one mentioned above. *Orthachne* differs from *Stipa* in the membranous texture of the lemma which does not inclose the palea. As Miss Hughes points out[4] *Orthachne* differs from the allied *Streptachne* R. Br. of Australia in having the palea equal to the lemma instead of much smaller and in having a joint at the base of the awn. The new species described below has the faintly 1-nerved ovate-lanceolate glumes, the equal palea, and the habit of *Orthachne* (the glumes are narrow and the first is 3-nerved in *Streptachne*), but the awn is continuous with the lemma (not jointed). It differs from both *Streptachne* and the original species of *Orthachne* in the pilose midnerve and margins of the lemma. It seems to be more closely allied to *Orthachne* than to the Australian *Streptachne*, hence is included in the former. *Orthachne breviseta* differs from *O. rariflora* in the short curved awn (instead of 2 to 3 cm. long and very flexuous), the continuous (not jointed) awn, and the pilose lemma.

Fig. 2.—Glumes, floret, and grain of *Orthachne breviseta*, × 5 dia.

Certain one-awned species of *Aristida* have been erroneously referred to *Orthachne* and *Streptachne*.

Orthachne breviseta Hitchc., sp. nov.

Perennial in dense tufts; culms erect or ascending, slender, glabrous, 15 to 30 cm. tall, having a single node near the base; leaves in a dense basal cluster; sheaths glabrous; ligules firm, obtuse, 1 to 2 mm. long; blades closely involute, glabrous, 0.3 to 0.4 mm. in diameter, sharp-pointed, somewhat curved or flexuous, 3 to 5 cm. long, the single culm blade below the middle, 1 to 1.5 cm.

[2] Bot. Antarct. Voy. 371. *pl. 131.* 1847.
[3] Syn. Pl. Glum. 1: 121. 1854.
[4] Kew Bull. Misc. Inf. 1923: 301. 1923.

long; panicles rather loose, 3 to 5 cm. long, somewhat nodding, the branches slender, glabrous, ascending, rather lax, 1 or 2 at a place, the lower as much as 2 cm. long; spikelets few, longer or shorter than the ultimate pedicels; glumes nearly equal, ovate-lanceolate, acute, 3 to 4 mm. long, glabrous, nerveless, the lower half purple, the upper half hyaline; lemma nearly terete, purple, about 4 mm. long, five-nerved, the intermediate pair of nerves very obscure, hairy between the lateral nerves and the margin, the midnerve densely short-pilose on the lower three-fourths, the callus short, acutish, densely short-pilose, the apex of the lemma gradually narrowed into a stout, scaberulous, curved, untwisted awn, 3 to 4 mm. long, the sides of the lemma extending upward as two short slender teeth at the base of the awn; palea acute, as long as the lemma and not inclosed in it, pilose between the 2 faint adjacent nerves.

Type in the Gray Herbarium of Harvard University, collected on Volcàn Yates, Province of Llanquihue, Chile, alt. 1300 meters, March, 1925, by E. Werdermann (no. 669). The type is the only specimen seen.

BOTANY.—*New grasses from Panama.*[1] AGNES CHASE, Bureau of Plant Industry.

In preparing manuscript on the grasses for the forthcoming Flora of the Panama Canal Zone, it is necessary to use names of new species that have been in manuscript for some time awaiting the completion of revisions of genera. The proposed Flora will not contain descriptions, for which reason the new species from the Canal Zone and immediate vicinity are described here. Two new combinations are also made.

Thrasya Hitchcockii Chase, sp. nov.

A tufted perennial; culms rather slender, about 70 cm. tall, ascending, simple except for axillary leafless long-peduncled racemes, very flat, sparsely pilose; nodes constricted, the lower short-pubescent; sheaths keeled, pilose, especially at the summit and along the margin, or the uppermost nearly glabrous; ligule firm-membranaceous, about 1 mm. long; blades 15 to 30 cm. long, 5 to 6 mm. wide in the middle (the uppermost reduced or obsolete) tapering to both ends, rather firm, finely pubescent on both surfaces and coarsely pilose, at least at the base and along the margins, as well, the pale midnerve prominent beneath; inflorescence terminal and axillary, the solitary arcuate racemes 10 to 20 cm. long, on long very slender angled pilose peduncles, 2 or 3 peduncles from the uppermost sheath; rachis 2 mm. wide, the narrow membranaceous margins upturned, glabrous, or with a very few long hairs on the edge; spikelets subsessile, spreading about 45°, somewhat crowded, oblong-elliptic, turgid, 3.5 mm. long, 1.8 mm. wide; first glume minute or obsolete; second glume slightly shorter than the sterile lemma, faintly 5-nerved, pilose on the upper third and along the margins; sterile lemma subacute, deeply sulcate, slightly indurate, but thinner down the center and prob-

[1] Received January 25, 1927.

ably splitting at maturity, faintly 5-nerved, the first lateral pair of nerves minutely crested at the apex, pilose along the margin near the summit, the sterile palea as long as its lemma, thin with firm nerves, subtending a rudimentary staminate flower; fruit elliptic, subacute, 3 mm. long, 1.5 mm. wide, the lemma and palea indurate, papillose-roughened, the lemma with a few stiff erect hairs at the apex.

Type in the U. S. National Herbarium no. 1,269,446, collected at the edge of a copse, on a hill, Chorrera, Province of Panama, September 16, 1911, by A. S. Hitchcock (no. 8140).

This species is intermediate between the two groups of *Thrasya*, the extremely specialized *T. petrosa* (Trin.) Chase and its allies and *T. cultrata* (Trin.) Chase and *T. campylostachya* (Hack.) Chase, which resemble *Paspalum pilosum* Lam.

Axonopus centralis Chase, sp. nov.

Perennial in large bunches; culms erect to stiffly spreading, simple except for the axillary inflorescence, 40 to 90 cm. tall, leafy throughout, compressed, glabrous; nodes glabrous; sheaths keeled, striate, hyaline-margined, usually pubescent on the overlapping edge, at least toward the summit, appressed-pubescent on the sides of the collar; ligule minute, firm, fimbriate; blades folded and keeled at base, flat above, rather lax, 15 to 50 cm. long, 8 to 10 mm. wide, rather strongly nerved, very sparsely pubescent on the upper surface, glabrous beneath, ciliate on the margin toward the base; inflorescence terminal and axillary, finally long-exserted on very slender striate peduncles, the terminal of 3 to 6 racemes, the axillary of 2 or 3, the upper 2 or 3 approximate, the lower remote, the common axis 1 to 6 cm. long; racemes 8 to 15 cm. long, lax, ascending or spreading, the slender rachis glabrous, minutely scaberulous on the angles; spikelets subsessile, mostly rather distant, oblong, 3 mm. long, 0.7 mm. wide, the glume and sterile lemma equal, extending one-third their length beyond the fruit, 3 nerved (rarely a faint outer pair in addition) or the midnerve commonly suppressed in the sterile lemma or in both, the lateral nerves of the glume extending into minute scabrous teeth at the apex, the internerves bearing a band of silky pubescence; fruit 2 mm. long, 0.7 mm. wide, oblong-elliptic, pale-stramineous.

This species is related to *Axonopus leptostachys* (Humb. & Bonpl.) Hitchc., from which it differs in its smaller size, fewer and much shorter racemes, and in the minutely dentate apex of the spikelet. This character has not been observed in any other species of the genus.

Type in the U. S. National Herbarium, no. 928831, collected in open grassland between Culebra and Pedro Miguel, Canal Zone, August 28, 1911, by A. S. Hitchcock (no. 7928).

Other specimens of this species are: PANAMA: Between Culebra and Pedro Miguel, *Hitchcock* 7928. Ancon, *Hitchcock* 19891. Taboga Island, *Hitchcock* 8077. NICARAGUA: Jinotepe, *Hitchcock* 8716.

Axonopus ater Chase, sp. nov.

A densely tufted perennial; culms ascending, simple except for the axillary inflorescence, 40 to 50 cm. tall, leafy at the base, compressed, glabrous; nodes appressed-pubescent; sheaths much shorter than the internodes, keeled, the margins stiffly ciliate; ligule minute, fimbriate; blades folded throughout,

keeled, rather stiff, 4 to 15 cm. long, 4 to 5 mm. wide (opened out), obtuse and scabrous at the apex, sparsely papillose-ciliate on the margin; inflorescence dark purplish brown throughout, terminal and axillary, long-exserted on very slender peduncles, the terminal of 2 to 5, the axillary of 2 racemes, 2 or 3 digitate, the others 5 to 12 mm. below; racemes 4 to 6 cm. long, widely spreading, the center angle of the slender rachis sharply raised; spikelets subsessile, not crowded, oblong-elliptic, 1.7 to 1.8 mm. long, 0.7 mm. wide, the glume and sterile lemma equal, covering the fruit but not exceeding it, strongly 2-nerved, the midnerves suppressed, blotched with blackish purple, glabrous or the glume very obscurely pubescent at base; fruit about the size and shape of the spikelet, pale stramineous, minutely papillose-striate, the lemma with a very minute tuft of hairs at the apex.

Type in the U. S. National Herbarium, no. 1,259,877 collected on moist clay on side of cut along railroad, Gatun, Canal Zone, September 2, 1911 by A. S. Hitchcock (no. 7976).

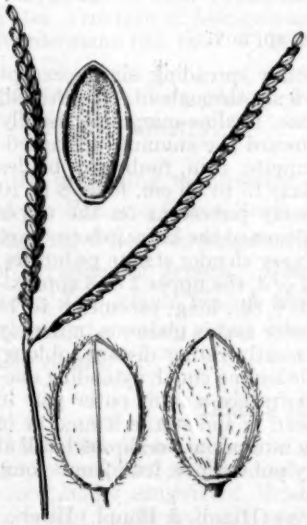

Fig. 1.—*Paspalum subciliatum*, inflorescence, natural size; spikelet and fruit, × 10.

This species belongs in the group that includes **Axonopus Purpusii** (Mez) Chase (*Paspalum Purpusii* Mez[2]) differing from the North American forms in the smaller, glabrous blackish spikelets, and from the few South American species of this group having glabrous spikelets in the smaller blackish spikelets with two-nerved glume and sterile lemma.

Paspalum subciliatum Chase, sp. nov.

A tufted perennial; culms erect and crowded from a short horizontal rhizome, the innovations short and subglobose, resembling bulblets at the base of flowering culms; culms simple, 15 to 45 cm. tall, slender, compressed, striate, glabrous, leafy below; sheaths striate, glabrous or with a few hairs on the margins at the summit, the lower mostly short and crowded, the upper one elongate and bladeless; ligule ciliate, about 0.5 mm. long; blades erect, folded at base and slightly wider than the sheath, flat above, drying more or less involute, with attenuate tip, 10 to 20 cm. long, 2 to 3 mm. wide (or occasional lower ones 5 to 8 cm. long and 5 mm. wide), long-pilose on the upper surface toward the base, otherwise glabrous; inflorescence long-exserted, with a dense tuft of short white hairs at base; racemes 2, conjugate (rarely a third below), narrowly ascending to spreading, 3 to 6.5 cm. long, one usually a little longer and naked at the very base; rachis slender, flexuous, glabrous, purplish; spikelets grayish green, solitary, subsessile, scarcely or not at all imbricate, elliptic, subacute 2.2 to 2.4 mm. long, 1.2 to 1.5 mm. wide; glume and sterile lemma equal, covering the fruit, 3-nerved, the glume minutely pubescent,

[2] Bot. Jahrb. Engler **56**: Beibl. **125**: 10. 1921.

the hairs longer around the margin, the sterile lemma ciliate toward the summit, otherwise glabrous; fruit pale, very minutely papillose striate.

Type in the U. S. National Herbarium, no. 734821, collected in a savanna, in the vicinity of Balboa, Canal Zone, September 6, 1911, by A. S. Hitchcock (no. 8017). *Pittier* 4500, collected in Sabana de Juan Corso, near Chepo, Province of Panama, also belongs to this species.

This species belongs to the Notata group, and somewhat resembles *P. minus* Fourn., from which it differs in the more slender culms, subglobose innovations, narrower blades and especially in the grayish spikelets, pubescent on the glume with a delicate fringe of hairs showing from the flat (sterile-lemma) side.

Paspalum centrale Chase, sp. nov.

Plants perennial, in small to rather dense and spreading tufts; culms often branching from the lower nodes, sometimes from the middle ones, ascending to spreading, occasionally geniculate and rooting at the lower nodes, 15 to 60 cm. tall (usually 30 to 45 cm.), compressed, ridged, glabrous; nodes glabrous; sheaths rather loose, mostly exceeding the internodes, from sparsely to conspicuously pilose, sometimes glabrous except near the margins, rarely throughout; ligule brown, membranaceous, 2 to 3 mm. long; blades flat, ascending, 5 to 25 cm. long, 3 to 10 mm. wide (commonly 10 to 20 cm. long and 5 to 7 mm. wide, the uppermost reduced), long-acuminate, about as wide at the base as the summit of the sheath, pilose throughout, often sparsely so or rarely subglabrous on the under surface; racemes 2 to 6, distant about $\frac{1}{4}$ to $\frac{2}{3}$ their length, or the upper closer, 2 to 7 cm. long, mostly widely spreading, often arcuate, the common axis slender, narrowly winged, rather stiff, sometimes bearing scattered long hairs toward the summits of the internodes, the rachises 1 to 1.3 mm. wide, long-pilose at the base, the hairs sometimes as much as 10 mm. long, hispidulous and sometimes with a few scattered long hairs on the margins and on the midnerve above; spikelets mostly solitary (the secondary one of the pair rudimentary, or a few developed in some racemes) slightly or scarcely imbricate, 2 to 2.3 mm. long, 1.7 to 1.8 mm. wide, elliptic obovate, olivaceous to brownish, glabrous; glume and sterile lemma barely or scarcely covering the fruit, rather fragile, 5-nerved, the outer one of the lateral pair sometimes obscure; fertile lemma and palea shining, very minutely papillose-striate, at first pale turning dark brown.

Fig. 2.—*Paspalum centrale*, inflorescence, natural size; spikelet and fruit, × 10.

Type in the U. S. National Herbarium, no. 950876, collected in open flat meadow near the coast, La Union, El Salvador, November 13, 1911, by A. S. Hitchcock (no. 8789).

Along ditches and in moist open ground near the coast Salvador to Panama. The following specimens are from the Canal Zone: PANAMA: Culebra, *Hitchcock* 7985, 8059. Balboa, *Hitchcock* 8004, 8005, 8008, Chivi Chivi, *Killip* 4077. Las Sabanas, *Pittier* 6817.

This species is closely related to *Paspalum Boscianum* Flügge from which it differs in being perennial, not so coarse and less branching in habit, in the pilose foliage, in the relatively slender racemes, with narrower rachises and mostly solitary, rather less turgid spikelets. The panicles of depauperate plants of *Paspalum Boscianum* with solitary spikelets resemble shorter-racemed panicles of *P. centrale*, but such plants are readily distinguished by the difference in foliage. The spikelets of *P. centrale* never assume the rust-brown color characteristically (but not constantly) found in those of *P. Boscianum*.

Paspalum Standleyi Chase, sp. nov.

A slender tufted perennial, forming leafy mats, the culms spreading, some of them rooting at the lower nodes or creeping: culms 20 to 27 cm. long, slender, compressed, simple or branching at the base, glabrous or sparsely pilose below the nodes; nodes bearded with ascending hairs, the upper sparsely so: leaves aggregate at base, the sheaths keeled, the lower rather broad, papillose-pilose, especially along the midnerve and margin and on the collar, the upper glabrous except on the margin and collar; ligule minute; blades flat, spreading, 3 to 6 cm. long, 3 to 6 mm. wide, rounded at base, sparsely papillose-pilose on the lower surface, papillose (or with a few hairs) to glabrous on the upper, the upper blades mostly suppressed; racemes 3 or 4, spreading, 2.2 to 4 cm. long, on a slender glabrous common axis 1 to 1.5 cm. long, the axils glabrous or nearly so, the slender rachis dark purplish, glabrous; spikelets solitary on short flat pedicels, scarcely imbricate, narrowly ovate, somewhat unsymmetrical, subacute, depressed-plano-convex, 1.6 mm. long, 0.9 mm. wide, glabrous, pale or purple-tinged; glume and sterile lemma equal, barely exceeding the fruit, the midnerve suppressed, the marginal nerves strong, the sterile lemma obscurely longitudinally wrinkled in the middle; fruit 1.5 mm. long, 0.7 mm. wide, pale.

Fig. 3.—*Paspalum Standleyi*, inflorescence, natural size; spikelet and fruit, × 10.

Type in the U. S. National Herbarium, no. 1,269,445, collected in marshy thicket, Juan Diáz, Province of Panama, January 11, 1924, by Paul C. Standley, no. 30543.

This species is allied to *Paspalum hyalinum* Nees of Brazil, from which it differs in its spreading habit, softer foliage, the blades much shorter and broader, and slightly larger spikelets, the thin glume and sterile lemma not hyaline and tearing in the middle as in *P. hyalinum*.

Paspalum acutum Chase, sp. nov.

A robust perennial, probably 2 meters or more tall; culms simple, glabrous, leafy to the summit; sheaths overlapping, compressed, striate, pilose on the margin at the summit, otherwise glabrous, the junction with the blade slightly constricted, dark colored; ligule membranaceous, 1.5 to 2 mm. long; blades about as wide as the sheath, slightly rounded and folded at base,

flat above, 30 to 75 cm. long, 14 to 18 mm. wide, long-acuminate, glabrous beneath, sparsely pubescent on the upper surface and with long hairs back of the ligule, the margins sharply serrulate, the uppermost blade greatly reduced; inflorescence scarcely exserted (in specimens seen), the main axis rather slender, 10 to 15 cm. long, plano-convex, scabrous on the margins; racemes 6 to 10, thick, heavy, nodding, 9 to 12 cm. long, with a tuft of long hair at the base, the rachis 1 to 1.5 mm. wide, slightly flexuous, scabrous-serrulate on the margin, otherwise glabrous; spikelets in pairs on minute slender pedicels, imbricate, olive-green, elliptic, 3.5 to 3.9 mm. long, 2 mm. wide, abruptly acute; glume and sterile lemma equal, abruptly pointed beyond the fruit, 5-nerved, the lateral nerves close together near the margins, the glume silky-ciliate on the margin near the summit or nearly glabrous (spikelets varying in a single raceme), the lemma glabrous; fruit elliptic, 3 mm. long, 1.8 mm. wide, pale-stramineous, the lemma and palea minutely papillose-striate under a lens.

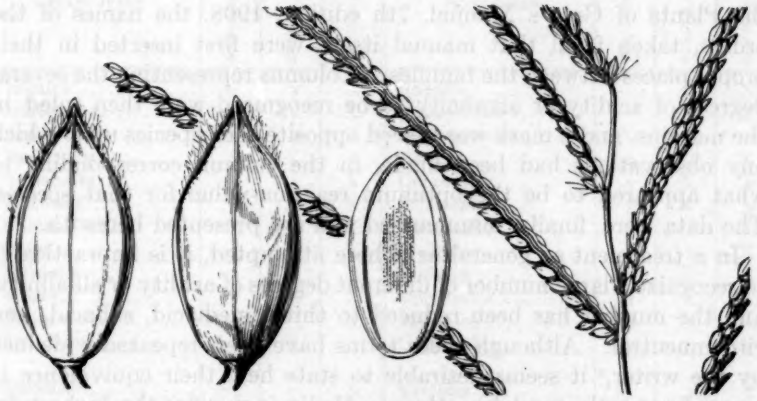

Fig. 4.—*Paspalum acutum*, inflorescence, natural size; spikelet and fruit, × 10

Type in the U. S. National Herbarium no. 1,037,443, collected in dry fields, Ancon, Canal Zone, September 18, 1917, by E. P. Killip (no. 4003).

The two specimens seen lack the base, but the species belongs to the Virgata group and is undoubtedly perennial. It differs from *Paspalum virgatum* L. in the more leafy culms and in the pointed elliptic spikelets, glabrous except the margin of the glume toward the summit, and in the pale fruit.

Sorghum vulgare sudanense (Piper) Hitchcock.

Andropogon sorghum sudanensis Piper, Proc. Biol. Soc. Washington **28**: 33. 1915.

Holcus sorghum sudanensis Hitchc. Proc. Biol. Soc. Washington **29**: 128. 1916.

PLANT ECOLOGY.—*The soil-reaction preferences of certain plant orders.*[1] EDGAR T. WHERRY, Bureau of Chemistry.

The data thus far published on the soil-reaction preferences of plants have referred chiefly to individual species or to ecological associations. It seems of interest to consider the matter from a different standpoint, namely, that of the orders into which plants naturally fall. The present study has been undertaken to ascertain whether any significant differences could be recognized in the soil-reaction preferences of the orders of higher plants represented in the northeastern United States.

The plan adopted was as follows. In a copy of the Check List of the Plants of Gray's Manual, 7th edition, 1908, the names of the orders, taken from that manual itself, were first inserted in their proper places between the families. Columns representing the several degrees of acidity or alkalinity to be recognized were then ruled in the margins, and a mark was placed opposite each species upon which any observations had been made, in the column corresponding to what appeared to be the optimum reaction-value for that species. The data were, finally, summarized and are presented herewith.

In a treatment so general as is here attempted, it is impracticable to recognize a large number of different degrees of acidity or alkalinity, and the number has been reduced to three, mediacid, subacid, and circumneutral. Although these terms have been repeatedly defined by the writer,[2] it seems desirable to state here their equivalence in terms frequently used by others. *Mediacid* signifies the highest degree of acidity commonly met in normal soils; in the "specific acidity" plan of statement it signifies an active acidity in the hundreds; in the logarithmic plan, it represents pH 4.1 to 5.0. *Subacid* represents, correspondingly, an active acidity in tens, or pH 5.1 to 6.0. Active acidity 10 or pH 6.0 appears to be the lowest degree of acidity at which oxylophytes or acid-place plants thrive. The plants which favor values of acidity lower than this seem, for the most part, to grow about equally well a similar distance on the alkaline side of the neutral point. The term *circumneutral*, which is accordingly applied to them, covers the range from an active acidity of 8 to an active alkalinity of 8, or from pH 6.1 to 7.9, inclusive.

[1] Received January 24.

[2] *Soil acidity, etc.* Ecology, 1: 160. 1920; Smithsonian Annual Report, 1920: 247. 1922. *Soil reaction in relation to horticulture*, Bull. Amer. Hort. Soc. 4: 1. 1926.

In Table 1 a dash (–) is placed in a column opposite the order name when no significant number of species belonging in that order appear to thrive best at the reaction indicated, a lower-case x when a moderate number of species do so, and a capital X when the majority of the species show that reaction-preference. The summary indicates that very few orders prefer mediacid soils, and that approximately two-thirds of those covered fall in the circumneutral group. It is hoped

TABLE 1.—The Orders of Higher Plants in the Northeastern United States and Their Apparent Soil-reaction Preferences

Plant order	Mediacid	Subacid	Circumneutral	Plant order	Mediacid	Subacid	Circumneutral
Filicales	–	x	X	Ranales	–	x	X
Equisetales	–	x	X	Papaverales	–	x	X
Lycopodiales	X	x	x	Sarraceniales	X	x	–
Coniferales	x	X	x	Rosales	x	x	X
Pandanales	–	x	X	Geraniales	x	X	x
Najadales	–	x	X	Sapindales	x	X	x
Graminales	x	x	X	Rhamnales	–	x	X
Arales	x	x	X	Malvales	–	x	X
Xyridales	x	x	X	Violales	x	X	x
Liliales	x	x	X	Opuntiales	x	x	X
Scitaminales	–	–	X	Myrtales	x	X	x
Orchidales	x	X	x	Umbellales	x	x	X
Piperales	–	–	X	Ericales	X	x	x
Salicales	–	x	X	Primulales	–	x	X
Myricales	x	X	x	Ebenales	x	X	x
Juglandales	–	X	x	Gentianales	x	x	X
Leitneriales	–	–	X	Polemoniales	x	x	X
Fagales	x	X	x	Plantaginales	–	x	X
Urticales	–	x	X	Rubiales	x	x	X
Santalales	x	X	x	Campanulales	x	x	X
Aristolochiales	x	x	X				
Polygonales	x	x	X	Number with each optimum	3	11	30
Chenopodiales	–	x	X				
Caryophyllales	x	x	X				

that these data may be of use in considering the geological history of the plant orders, the reasons for their present distribution, and similar problems. Perhaps some day discussions of "reaction and range" may take the place of the current one on "age and area." The present preliminary note may serve to indicate to what extent differences between the soil-reaction preferences of plant orders may be looked for.

ENTOMOLOGY.—*Some scoliid wasps from tropical America.*[1]

S. A. ROHWER, Bureau of Entomology, United States Department of Agriculture.

Recently I have received from Mr. Harold E. Box certain specimens of scoliids for identification. Among these was one species which was being introduced into Porto Rico to help in the control of white grubs. This species is new, and its description, along with some related forms and a species of *Elis*, is presented at this time to make the names available to authors who may be dealing with the economy and habits of these species.

Genus CAMPSOMERIS Guérin

GROUP TRICINCTAE

Some of the species here grouped around *tricincta* (Fabricius) were assigned by Saussure and Sichel[2] to their species group *plumipedis*. The other previously described species was characterized subsequent to Saussure's and Sichel's work. The species of the group *tricinctae* can be distinguished from *plumipes* and allies by the presence of dense red or reddish hair on the apical segments of the abdomen and the presence of a patch of hair on the wing membrane adjacent to the stigma. The following characters are common to all females of the group *tricinctae:*

Length 12–20 mm. Black; basal three or four tergites marked with yellow; head and thorax clothed with fulvous hair; thorax in some species marked with yellow; terminal abdominal segments clothed with fulvous or rufous hairs; wings infumate or subhyaline, costa usually darker and usually a dusky spot at end of radial cell (indistinct in *limosa*); area adjacent to stigma densely clothed with hair (less so in *limosa*).

Males of only two (*tricincta* and *fulvohirta*) of the species are in the National Collection. They may be assigned to this group by the dense red hair at the end of the abdomen.

KEY TO THE FEMALES OF GROUP TRICINCTAE

1. Posterior aspect of propodeum sloping, not sharply separated from the dorsal aspect which is closely covered with distinct, large punctures; sternites all black.....2.
   Posterior aspect of propodeum perpendicular, sharply separated from dorsal aspect which is without *close* uniform punctures; sternites marked with yellow; area inclosed by first cubital and at least most of radial cells clothed with long hair; a dark spot beyond apex of radial cell....3.
2. Dorsal part of posterior aspect of propodeum closely and coarsely sculptured; yellow markings on tergites interrupted into spots; only anterior part of area inclosed by first cubital cell clothed with hair; no distinct dark spot beyond radial cell.....**limosa** (Burmeister).

[1] Received January 28, 1927.

[2] Cat. Species Gen. Scolia, 243. 1864.

Dorsal part of posterior aspect of propodeum smooth, almost without punctures; first three tergites with yellow bands; area inclosed by first cubital and radial cells clothed with brown hair; wing beyond radial cell dark brown.....**completa,** new species.

3. Disk of propodeum separated from the posterior aspect by a transverse ridge which is higher medianly; legs rufous; yellow markings of tergites forming continuous bands; pronotum without yellow spots **tricincta** (Fabricius).

No transverse ridge separating disk of propodeum from the posterior aspect; femora, at least, black; yellow markings of tergites usually forming lateral spots.....4.

4. Metanotum with a yellow spot and about two-thirds as long as dorsal aspect of propodeum; disk of propodeum with a lot of long bristle-like hairs; fourth tergite with a small yellow spot on each side **hesterae,** new species.

Metanotum black and about three-fourths as long as dorsal aspect of propodeum; disk of propodeum with dense appressed pile and without a bunch of bristle-like hairs; fourth tergite black....**fulvohirta** (Cresson).

CAMPSOMERIS (CAMPSOMERIS) LIMOSA (Burmeister)

Scolia limosa Burmeister, Abh. Naturf. Gesel. Halle, **1**: (pt. 4) 28. 1853. Female and male.

Elis limosa (Burmeister) Saussure, Ann. Soc. Ent. France, ser. 3, **6**: 246. 1858.

Elis (*Dielis*) *limosa* (Burmeister) Saussure and Sichel, Catal. Species Gen. Scolia, 250. 1864. (Judging from variation allowed these authors had more than one species included under this name).

All the specimens of this species before me are from Mexico and the following definite localities are included: Huipulco (August 29, 1922, E. G. Smyth); Coapa, D. F. (August 18, 1922, E. G. Smyth); Oaxaca (September, 1923, E. G. Smyth, Chittenden no. 13670); District Federal (L. Conradt). These specimens show but little variation in structure or color, and agree well with the original description. The absence of a distinct, infuscate spot beyond the apex of the radial cell helps to distinguish this species.

Turner[3] synonymizes (*mexicana* Cameron) = *rokitanskyi* Dalla Torre with *limosa*. Judging from the original description by Cameron this cannot be correct. Cameron very definitely states that the apical segments of the abdomen have black hairs, while in *limosa* the apical segments of the abdomen are clothed with red hair.

Campsomeris (CAMPSOMERIS) **completa,** new species

This species comes nearest to *limosa* (Burmeister) but the differences given in the above key should make it easy to distinguish the two forms. The complete yellow bands on the tergites and general habitus suggests relationship with certain of the species which have the pubescence of the head and thorax pale and of the apical tergites black. The color of the pubescence is

[3] Ann. Mag. Nat. Hist. ser. 8, **8**: 624. 1911.

distinctive and until the species of the other group have been carefully studied it is impossible to point out the relationships in this direction.

Female.—Length 16 mm. Clypeus gently convex, covered with coarse longitudinal wrinkles; frons, vertex and occiput smooth with only a few widely scattered punctures; basal joints of the flagellum spinose at apex beneath; pronotum with close, distinct punctures; mesoscutum with large, distinct, rather close punctures except over a small median area; scutellum smooth, with a median longitudinal impressed line and a few large punctures laterally; metanotum with large distinct punctures on basal portion, its median length about two-thirds the median length of dorsal aspect of propodeum; posterior face of propodeum sloping, not distinctly separated from the dorsal aspect, the median part smooth and with only a few scattered punctures, the lateral parts with small punctures dorsally; dorsal aspect of propodeum with uniform, distinct, close punctures; tergites dull, with a few scattered setigerous punctures; sternites polished, with scattered setigerous punctures which are arranged in two rows on the third and are more numerous and closer on the base of second and apex of fourth; apical margin of radial cell oblique above, arched outwardly below and exceeding the second cubital cell. Black; first three tergites with transverse apical yellow bands, that on the first slightly indentate medianly, that on the second with two broad forward projections laterally, that on the third broadly produced forward medianly; tegulae, tarsi and spines on tibiae rufo-piceous; head, dorsum of thorax and apical two abdominal segments with long ferruginous hair; sides of thorax, femora and basal abdominal segments with long gray hair; appressed pile gray, not abundant, occurring only on sides of thorax and posterior aspect of propodeum. Wings dusky hyaline, costal margin of fore wings ferruginous basally and followed by an elongate brown area beyond the radial cell; area inclosed by first cubital, radial and part of second cubital and median cells covered with brown hair.

One paratype shows a narrow yellow band on the fourth tergite and another is only 14 mm. long. Otherwise there is very little variation in the specimens in the type series.

Type locality.—Victoria, Mexico.

Other localities.—Cerro, Mexico, and Guanajuato, Mexico.

Described from three (one type) females from the type locality collected March 16, 1922, by T. C. Barber and T. E. Holloway; from one female from Cerro, collected October 28, 1922, by E. G. Smyth; and one female from Guanajuato.

Type and four *paratypes.*—Cat. no. 40167 U. S. N. M.

CAMPSOMERIS (CAMPSOMERIS) TRICINCTA (Fabricius)

Tiphia tricincta Fabricius, Systema Entom., 354. 1775; Spec. Insect. 1: 451. 1781; Mant. Insect. 1: 280. 1787; Entom. Systema, 2: 227. 1793; Systema Piez. 235. 1804.

Elis (*Campsomeris*) *tricincta* (Fabricius) Saussure, Ann. Soc. Ent. France, ser. 3, 6: 246 and 248. 1858. Female.

Elis (*Dielis*) *tricincta* (Fabricius) Saussure and Sichel, Cat. Species gen. Scolia, 248. 1864. Female and male. (Probably only for those specimens from the West Indies).

Campsomeris (*Campsomeris*) *pyrura* Rohwer, Proc. U. S. Nat. Mus. 49: (no. 2105), 235. 1915. Female and male.

There seems to be nothing in the original Fabrician description of this species, or any of the subsequent descriptions by the same author, to justify the assumption of Saussure that it was described in the male. While the original description applies fairly well to the male, the male has more yellow markings on the thorax than is called for. The description does apply very exactly to the female and the original mention that the first joint of the antenna is ferruginous makes the identity nearly certain. In fact the mention of this character convinced me that the specimens to which I gave the name *pyrura* were really *tricincta*. There seems no reason to doubt the above synonymy.

The original description gives the locality as, "Habitat in America Dom. v. Rohr." and Saussure and others have considered that the species occurred in a number of the islands of the West Indies as well as in Mexico. It may be that the species does occur in many islands of the West Indies and in Mexico, but it seems more probable that in recording this distribution authors have confused other forms with *tricincta*. I have seen this species from the following localities:—PORTO RICO: Mayaguez (types of *pyrura*), Mamayes Santa Rita, San Juan, Maricao, Arecibo, Adjuntas, Manati, Aibonito, Naguabo, Cayey, and Barros. HAITI: Port au Prince.

Campsomeris (CAMPSOMERIS) **hesterae,** new species

It seems probable that this species will be found in some collections under the name *limosa* (Burmeister) as the variation permitted for *limosa* by Saussure indicates they had more than one species under that name. Besides differing from *limosa* by the characters mentioned in the above key, the species may be separated from *limosa* by the distinct black mark which occurs in the fore wing beyond the end of the radial cell. This new species is more closely allied to the West Indian *fulvohirta* (Cresson) and may be found to vary so as to be distinguished from Cresson's species with difficulty. The material before me can be easily distinguished by the characters given in the foregoing key.

Female.—Length 18 mm. Head smooth with only a few scattered punctures, these closer on the vertex; clypeus convex, smooth, with punctures only basally; apical joint of antenna shorter than the two preceding, truncate apically; pronotum with close, distinct punctures; mesoscutum smooth medianly, laterally with close, distinct punctures; scutellum smooth, with a few large, distinct punctures laterally and basally; metanotum with distinct punctures along basal margin, two-thirds as long medianly as the median dorsal aspect of the propodeum; propodeum truncate posteriorly, the posterior aspect smooth, perpendicular and distinctly differentiated from the dorsal aspect; dorsal aspect of propodeum with close, uniform, rather large punctures, not produced medianly or separated from the posterior aspect by a carina or ridge; tergites dull, with a few scattered setigerous punctures; sternites shining, smooth, the second with many rather close punctures basally, remaining sternites with scattered setigerous punctures; radial cell oblique apically and exceeding the second cubital cell. Black; median spot on metanotum, lateral spots on first four tergites (those on second and third

narrower laterally), apices of anterior femora beneath and bases of anterior tibiae exteriorly yellow; tegulae, tibiae and tarsi rufo-ferruginous; head, dorsum of thorax, apical margins of tergites, all of fifth and sixth tergites, the three apical sternites and tibiae and tarsi clothed with long ferruginous hair; sides, venter of thorax and dorsal aspect of propodeum with fine appressed, pale golden pile; hairs of sides of thorax, femora, base of first tergite and basal sternites pale yellow. Wings dusky hyaline, costal margin ferruginous basally, beyond the radial cell with an elongate subviolaceous spot; area inclosed by the first cubital and radial cells clothed with long dark brown hair.

The paratype from Guatemala is 20 mm. long. One paratype from Venezuela is 17 mm. long. Another paratype from Venezuela is 14 mm. long, has two small yellow spots on the scutellum and two yellow spots on the pronotum. A paratype from "Ecua" is 22 mm. long and has the spots on the first three tergites connected forming complete bands, those on tergites two and three being deeply emarginate medianly.

Type locality.—Tucuche, Trinidad, British West Indies.

Other localities.—Cayuga, Guatemala; Las Adjuntas, Venezuela; "Ecua" (Ecuador).

Described from two females (one type) from the type locality collected May 31, 1925, by Hester M. Rohwer; one female from Guatemala collected June, 1915, by W. Schaus; three females from Venezuela collected June 29 and 30, 1926, and July 12, 1926, by H. E. Box; and one female from "Ecua" from C. F. Baker collection.

Type and five *paratypes.*—Cat. no. 40168 U. S. N. M.

One paratype returned to H. E. Box.

The material collected by Mr. Box was sent under his number "E" and accompanied by a note stating that the species had been collected at Guatire (300 meters), Venezuela; that it frequented flowers of *Clibadium, Melochia* and (?) *Wedelia;* that it had been introduced into Porto Rico and had arrived there alive and oviposited regularly on grubs of *Lachnosterna portoricensis.*

Campsomeris (Campsomeris) fulvhirta (Cresson)

Scolia (*Elis*) *fulvohirta* Cresson, Proc. Ent. Soc. Phila., **4**: 119. 1865. Female and male.

In two of the females from Santiago, Cuba, before me the pronotum is entirely black. Three females from Santiago, Cuba; one female and one male from Taco Taco, Cuba, April 1–6, 1922. The last two mentioned specimens agree almost exactly with the original description. Also one male from Portland, Jamaica, determined by W. J. Fox.

Two females collected at Miami, Florida, May, 1917, by W. M. Mann are assigned here. They differ from the Cuba specimens in having the yellow spots on the tergites somewhat smaller and in having the third sternite black.

Genus Elis Fabricius

Elis caracasana, new species

The species is probably more closely allied to the species *toluca* (Cameron), *centralis* (Cameron) and *parvimaculata* (Cameron), but it differs from these species in having the abdomen black except for a yellow band on the first tergite. It also resembles *montivaga* (Cameron), but besides the difference in color of the abdomen, it may be distinguished from Cameron's description in

having the basal median area of the propodeum not roughened. The large spines on the legs are whitish instead of being rufous. The species is rather characteristic and may readily be recognized by its dark color, the infuscated costal margin of the wing and the coarse sculpture of the frons.

Female.—Length 17.5 mm. Clypeus with large, irregular, sometimes confluent punctures, anterior margin almost without sculpture and nearly truncate; frons with coarse, irregular, sometimes confluent punctures and with distinct, deep, impressed line from between bases of antennae to almost the anterior ocellus; area surrounding the ocelli and vertex shining, with large, scattered punctures; distinct transverse groove behind posterior ocelli; posterior orbits smooth but with a few punctures along the hind margin; dorsal aspect of the pronotum opaque, granular and in addition with large, irregular, sometimes confluent punctures; mesoscutum bipunctate, the large punctures widely distributed and in the posterior part of the median area they are elongate; scutellum unipunctate with large, scattered punctures; dorsal aspect of the propodeum opaque, finely granular, with no distinct area set off by large punctures; posteriorly the dorsal aspect is irregularly wrinkled and this irregular wrinkling extends onto the sides of the posterior aspect; posterior aspect with the median area with dorsad-ventrad aciculations; mesepisternum with large, close, distinct punctures; sides of the propodeum with oblique rugae and with the areas between the rugae aciculate; first tergite with small, separate punctures; the second, third and fourth tergites with the punctures slightly larger and closely crowded together; the fifth tergite bipunctate but the small punctures rather inconspicuous and the larger punctures not much larger than those on the posterior margin of the fourth tergite; pygidium longitudinally striate for its entire length; sternites with large, scattered punctures near their apical margins; inner calcarium of the posterior tibia strongly curved basally and with a prominent tooth at the end of the curved portion; fourth abscissa of the cubitus subequal in length with the second intercubitus and shorter than the third abscissa of the radius, but slightly longer than the fifth abscissa of the cubitus. Black; head, thorax and legs and ventral part of abdomen with scattered, glistening white hairs; the ventral part of the anterior face of the first tergite with a patch of long white hair; first and second tergites with a faint violaceous reflection; median posterior spot on the scutellum, metanotum medianly, a median longitudinal line on dorsal aspect of propodeum, lateral posterior angles of propodeum, oblique spot on side of propodeum, a transverse band on the first tergite medianly (dilated at the sides) yellow; wings subhyaline, the costal margin deeply infuscated and with a violaceous tinge; venation black.

Paratypes show the species may vary in size from 18 to 12 mm., that the oblique yellow spot on the sides of the propodeum may be wanting, and that there may be elongate yellow spots on the sides of the third tergite basally.

Described from eight females (one type) collected by Harold E. Box in July, 1926, at Las Adjuntas, near Caracas, Venezuela, 960 meters above sea level, on flowers of *Clibadium surinamense* and *Melochia caracasana*.

Type and paratypes.—Cat. no. 40239 U. S. N. M.

One paratype returned to sender.

SCIENTIFIC NOTES AND NEWS

The American Geophysical Union will hold its eighth annual meeting April 28 and 29, 1927, at the National Academy of Sciences, 21st and B Streets, Northwest, Washington, D. C., with the following schedule of meetings.

Thursday, April 28.—9:30 a.m. to 12:30 p.m., Sections of Geodesy and Terrestrial Magnetism and Electricity.—2:30 p.m. to 5:30 p.m., Sections of Volcanology and Oceanography.

Friday, April 29.—9:30 a.m. to 12:30 p.m., Sections of Meteorology and Seismology.—2:30 p.m. to 5:30 p.m., General Meeting of the Union.

New York University is now arranging for the installation, in its new Daniel Guggenheim School of Aeronautics, of a wind tunnel which will represent the most up-to-date equipment in this country for testing airplane models. It is estimated that air velocities in the tunnel will exceed 100 miles per hour.

The Petrologists' Club met at the Geophysical Laboratory on February 15. JAMES GILLULY reviewed Twenhofel's *Treatise on sedimentation*, and J. B. MERTIE reviewed Tarr's *Origin of chert and flint*, adding new observations of his own on chert formations in Alaska. L. LAFORGE, in an informal communication, showed a fragment of vein quartz containing unusual casts of a pyroxene, some of which completely penetrated the block.

Dr. ROBERT H. LOMBARD resigned from the Geophysical Laboratory on March 1, to join the research laboratory of the Norton Company, manufacturers of grinding wheels and refractory products, at Worcester, Massachusetts.

Mr. O. W. TORRESON sailed from New York for Peru on February 17 to relieve Mr. R. H. Goddard who has been in charge of the Huancayo Magnetic Observatory two years.